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Weed Control

Weeds cost farmers billions of dollars each year. ARS scientists believe the cost can be cut and are working toward this goal.

Science has brought farmers sophisticated mechanical weed control methods. Millions of acres of weeds are now controlled with chemicals. Recent ARS weed control research is reported on pages 8–11.

Much remains to be done, however, in improving and perfecting present methods of weed control, and in combining various approaches for coordinated control programs.

Scientists are working now to develop more chemicals that are selective for specific weeds in specific crops.

Biological control may see wider use in the future. Insects now control some field and aquatic weeds, and ARS scientists are searching the world for more weed-eating insects (p. 10). Researchers are also investigating the possible use of bacteria, fungi, and viruses for weed control.

Cultural control holds promise, and scientists are working to develop crop rotations that will control weeds. An example is nutsedge, which can be controlled by following corn or sod with soybeans. The wide leaves of the soybean plant shade the weed, and cultivation helps keep it under control.

By studying the basic nature of weeds, scientists are learning more about how they grow and develop. Such basic knowledge may enable scientists to control weeds by changing their growth habits.

Some perennial weed species, for example, have growth buds that become active when the tops of the weeds are removed. If scientists are able to prevent these buds from becoming active, the weeds would no longer be perennial.

Researchers are also trying to find substances that will control the germination of weed seeds. Some chemicals may inhibit germination—thus preventing weeds from developing. Others may stimulate germination—making it possible to use chemical or mechanical control on different weeds at the same time.

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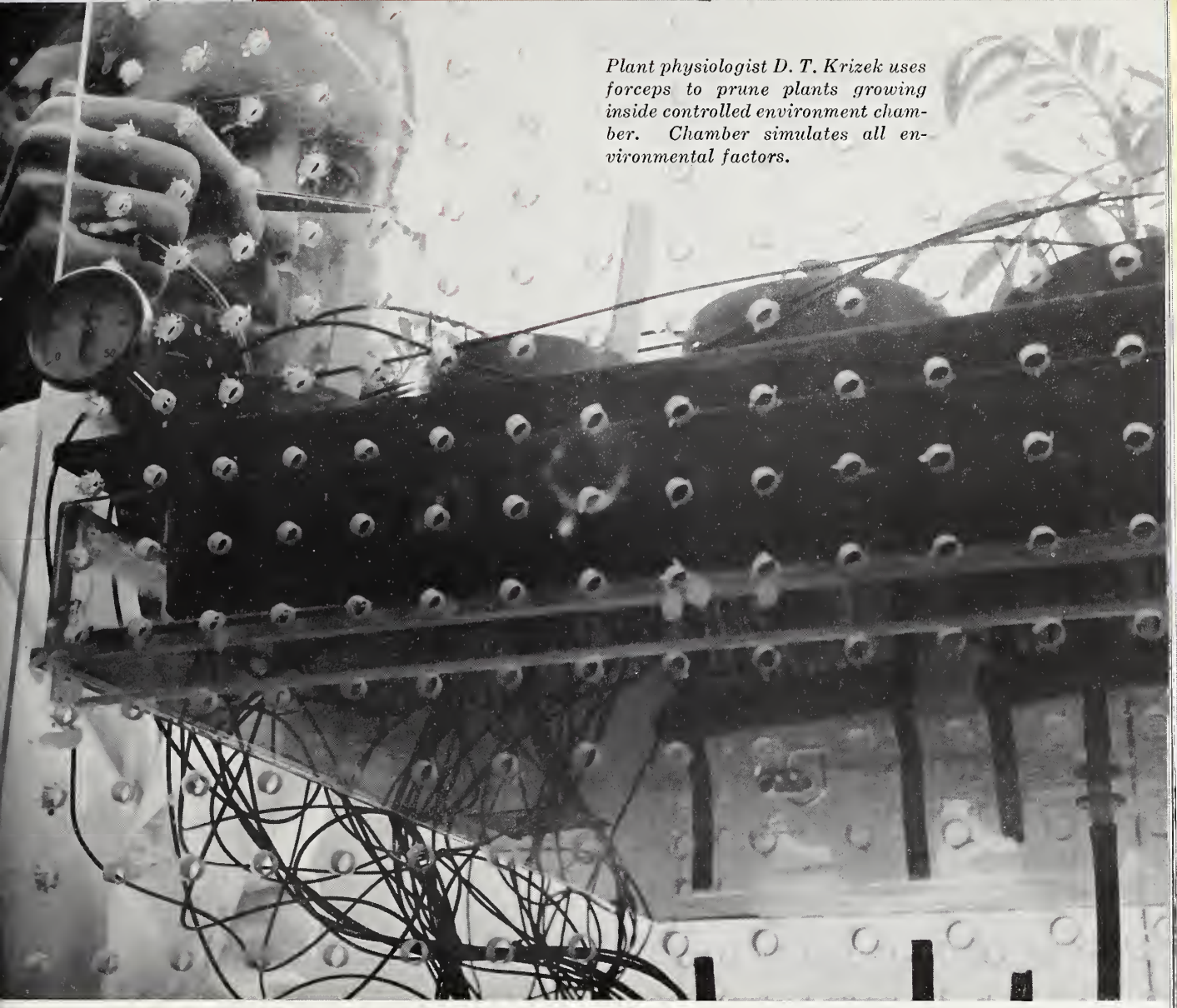


Plant physiologist D. T. Krizek uses forceps to prune plants growing inside controlled environment chamber. Chamber simulates all environmental factors.

ST–1792–6

Laboratory Established to

STUDY PLANT GROWTH

BRINGING OUTDOOR weather into the laboratory is the best way to study the effects of environment on plant growth.

ARS scientists will do just that in a new laboratory at Beltsville, Md. They will grow plants indoors in a simulated, completely controlled "outdoors." This research complex, called the Phyto-Engineering Laboratory, will also aid in designing new and better controlled environment equipment for other plant scientists.

Controlled environment studies are becoming increasingly important to agriculture. Air pollution threatens many of the crops near our large cities. And, as a nation, we look forward to establishing a colony on the moon—a colony whose people will live and, perhaps, grow their food under controlled environment conditions.

Studying the effect of environment on plant growth and development has not been possible under standard greenhouse conditions. In present-day greenhouses, low light intensity in the winter and excessively high temperatures in the summer limit optimum plant growth and cut research

Laboratory Established to

STUDY PLANT GROWTH

(Continued)

Engineer H. H. Klueter uses a standard light meter to measure the light given off by an instrument that supplies artificial light to plants.

ST–1794–4

ST–1793–5

Engineer W. A. Bailey checks equipment in experimental greenhouse that will be used to study the effects of solar radiation on plants.

projects short. Still less ideal is the normal environment of field plots where water stress (hard rains, water runoff, drought), insect and disease damage, insufficient nutrients, and capricious weather changes restrict or hamper growth.

Agricultural engineers and plant scientists will use the new Beltsville laboratory to determine criteria for constructing plant growth chambers and greenhouses that will provide maximum control of light quality, intensity, and duration; temperature; and humidity.

The scientists will also investigate ways of increasing plant growth, promoting early flowering, and manipulating life span by an interplay of controlled environment and chemical growth regulators.

To find part of the information they will need, the scientists will study the biochemistry and physiology of seed germination, photosynthesis, stem elongation, flowering, aging, and other plant growth phenomena.

The laboratory was designed by agricultural engineers W. A. Bailey and H. H. Klueter. Bailey, Klueter, and plant physiologist D. T. Krizek will direct the laboratory.

The 36- by 72-foot building, which contains offices for the scientists as well as laboratories, is constructed of prefabricated units of enameled steel and textured masonry. Extending behind the laboratory building is an 80- by 100-foot concrete slab on which several experimental greenhouses will be designed, fabricated, and tested for the effect of shape and orientation on heating, cooling, and solar radiation.■

TEST AIDS TOMATO PROCESSORS

TOMATOES CAN BE processed to the desired consistency—thin juice or firm gel, and practically any product between these extremes—by adjusting the acidity when the tomatoes are crushed.

J. R. Wagner and J. C. Miers, chemists in the ARS Western utilization research laboratory at Albany, Calif., have developed and refined the controlled acidity technique for this purpose. It gives better control over a wider range of product consistency than the heat treatment now used in commercial processing plants.

In addition to its potential value as a processing method, the acid treatment analyzes raw tomatoes for "consistency potential," an important quality factor for many tomato products. The need for an accurate method to measure consistency potential has become more acute with increased machine harvesting because machine-harvested crops vary more in quality than hand-harvested crops.

The new treatment can be used in manufacturing the full range of strained tomato products—juices, catsups, sauces, pastes, and purees.

It may result in more economical tomato products, improved quality, and even new products.

Test results indicate that the yield of tomato product from a given amount of raw tomato may be about 1 percent more than is obtained in present commercial processing. This increased yield has a potential yearly gross value to manufacturers of several million dollars. The wholesale value of the annual pack of U.S. tomato products in which consistency is important is more than $300 million.

To determine processing quality of raw tomatoes with the controlled acidity method, the scientists add acid to tomato samples before crushing, then squeeze out the juice and determine its viscosity by measuring the rate of flow through a pipette. This test is in commercial use on a trial basis.

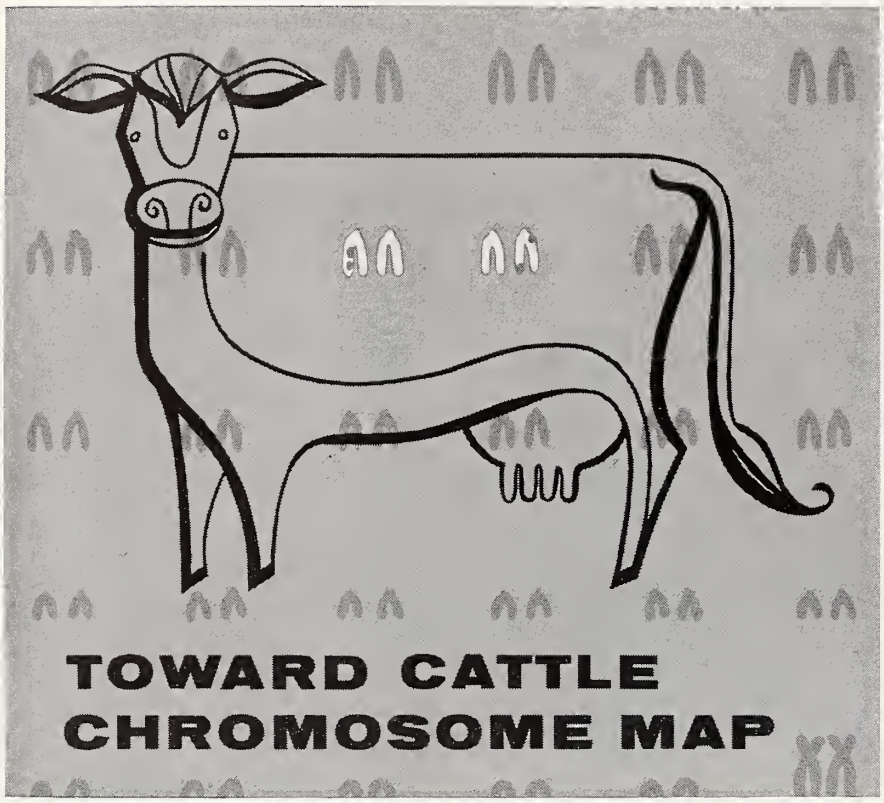
Normally, when tomato tissues are crushed, the enzymes pectinesterase and polygalacturonase are activated and immediately begin to degrade the pectic substances that give consistency to tomato products. If the enzymatic action is not stopped, it will thoroughly degrade the pectins and the product will be thin. Either heat or acid stops the enzymatic action.

When Wagner and Miers use the controlled acidity treatment in experimental processing, they crush tomatoes at the desired level of acidity by adding carefully measured amounts of acceptable alkaline or acid substances. By adjusting the acidity level at the time the juice is extracted, they can obtain a product with almost any desired consistency—from thin juice to firm gel.

After obtaining a product of the desired consistency, the scientists restore the original acidity level. The net effect on composition of the product is the addition of salt, which is commonly added to tomato products. There is no effect on purity or healthfulness of the product.■

PN–1471

Scientist runs tomato juice through pipette and measures rate of flow. Acid is added to tomato before it is crushed. The test is already in commercial use on a trial basis.



TOWARD CATTLE CHROMOSOME MAP

Symbolic illustration shows 30 pairs of chromosomes. Although researchers know that 2 genes are close together on one chromosome and 2 genes are far apart on another, they do not yet know which chromosomes carry these genes.

ARS DAIRY CATTLE geneticists have taken the first step toward developing a chromosome map—a tool that will help researchers and farmers do a better job of selecting cattle breeding stock.

They have discovered the location and relationship of four of the many genes (specific units of inheritance) that make up this map for dairy cattle.

Although there is room for many thousands more genes in the chromosome map of cattle, the geneticists think their find is an exciting step forward. The four points they have established help orient the map, in much the same way as knowing just a few points on a city map orients a stranger who is unfamiliar with a town. The rest of the work will be easier, although it will take time.

Because chromosomes determine the characteristics of an animal, a chromosome map is an individual's genetic blueprint. Details of the blueprint would show an animal's genetic potential for each mapped trait—thereby showing much about an animal's value for breeding.

Chromosomes are often described as chains because they are composed of hundreds of genes linked together. Because genes are impossible to tell apart even with a microscope, geneticists deal with them through the changes they bring about in animals—blood groups, coat color, or presence or absence of horns. Genes that are on the same chromosome will be passed along together from parent to offspring; geneticists can establish gene linkage by observing the association between two traits in many individuals.

Infrequently, but regularly, two chromosomes in a pair intertwine and exchange parts. Continued checking on associations between traits, therefore, tells scientists the distance between two genes on a chromosome—the more frequently two genes are separated by a chromosome break, the farther apart they must be. Eventually, this yields a rather precise map of where each gene is located.

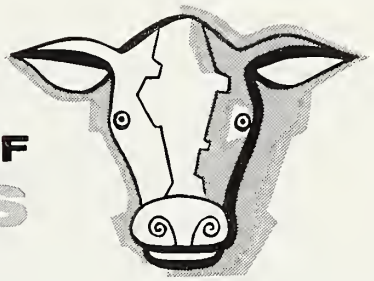
The difficulty of making chromosome maps increases with the number of chromosomes a species has. A detailed map has been made for fruit flies, which have just four pairs of chromosomes. Dozens of genes have already been mapped for humans, who have 23 chromosome pairs. But until recently, all scientists knew about the map of cattle chromosomes (there are 30 pairs), was that the genes for each of 11 blood groups seemed to be on different chromosomes.

Now, a pool of data among cattle geneticists reveals two instances of linkage—four points on the nearly blank map. One linkage is between the "J" blood group and the whey protein, beta-lactoglobulin. These two genes appear quite far apart on the chromosome. The second discovered linkage, between two other milk protein genes, is rather close.

Variations in milk proteins were discovered during the last few years by scientists in ARS and at other institutions. They have greatly increased the number of known gene effects available for mapping studies (AGR. RES., June 1965, p. 6).

Cooperators in the recent exchange of data to start the cattle chromosome map were ARS geneticists C. A. Kiddy and W. W. Thatcher at Beltsville, Md.; ARS chemist M. P. Thompson at Philadelphia, Pa.; ARS cooperator H. C. Hines at Columbus, Ohio; and researchers at the University of Maryland, College Park, and at research centers in Edinburgh and Shinfield, Great Britain.■

TOWARD MORE KNOWLEDGE OF MILK PROTEINS



As SCIENTISTS UNRAVEL the complexities of milk proteins, one protein — kappa-casein — emerges as the key to milk's physical stability.

A complex of the caseins with calcium and phosphate is dispersed in milk in a form called a colloid. Since the kappa-casein is essential to keeping this colloid stable, it is a subject of great interest to scientists seeking to preserve the quality of fresh and processed milk.

The gelling and sedimentation that can occur during the storage of concentrated milk are caused by a disruption of this colloid. If dried milk has a chalky texture when reconstituted, it is probably because these colloidal particles are not completely redispersed.

C. A. Zittle and J. H. Woychik, chemists at the ARS Eastern utilization research laboratory in Philadelphia, have made important contributions to the knowledge that the key role played by casein in maintaining the colloid is primarily that of kappa-casein. (About 10 to 15 percent of the casein is kappa-casein; the major components are alpha-casein and beta-casein.)

Zittle made one of the major early findings. He showed that alpha-casein and beta-casein can be precipitated out by calcium ions if kappa-casein is not present, but remains in colloidal suspension if kappa-casein is present.

Another indication of the importance of kappa-casein to milk stability is that it is the only part of the casein attacked by the enzyme rennin. Rennin starts the process of converting milk to cheese by depriving the milk of the stabilizing action of its kappa-casein.

But much less is known about kappa-casein than about alpha- or beta-casein. While alpha and beta can be readily studied by a powerful technique known as gel electrophoresis, kappa is not directly susceptible to electrophoretic analysis. It exists as a large aggregation of molecules chemically b o n d e d together. As such it resists being moved through the gel used in this procedure.

Woychik overcame this barrier. He found a way to reduce kappa-casein (to break the bonds between its molecules) so that the protein can be resolved into its component parts by gel electrophoresis.

Woychik found two major components and five or six minor ones in reduced kappa-casein. The minor components are essentially identical, chemically, to the major ones, but are electrophoretically distinct because of varying amounts of carbohydrates that are attached to them. The major components are free of carbohydrates.

Reduction of kappa-casein, Woychik found, did not affect its stabilizing ability or its action with rennin. Furthermore, all of its individual components had the same properties as the undivided protein.

These findings indicated that the bonds between the kappa-casein molecules are not essential to its stabilizing properties. A study of the various amino acids making up the different kappa-casein fractions did not show important differences.

Zittle continued the basic studies with another investigative technique—photooxidation. I n t h i s process certain of the amino acids of the protein can be altered by the action of light in the presence of a colored compound, but the bonds between the molecules are not broken.

When Zittle photooxidized kappa-casein, he dramatically altered the properties of the protein: it could no longer prevent calcium ions from precipitating out alpha- and beta-casein, and it could no longer be acted on by rennin.

Studies of the amino acid composition of photooxidized kappa-casein showed that all of its histidine and most of its tryptophan had been oxidized by the process. This suggests that these amino acid residues may be located at sites on the molecule where the kappa-casein attaches itself to the rest of the casein, keeping the casein-calcium-phosphate complex of milk in solution. It also suggests that rennin action may take place in the area of these residues.

Much more remains to be done before this basic research can be related to practical milk processing problems. For one thing, the scientists are not quite sure that the altered *chemical* structure of photooxidized casein is responsible for its changed properties. There is some indication that photooxidation increases the tendency of the protein to aggregate, and it may be this *physical* clumping together of the kappa molecules that deprives them of their normal stabilizing influence.■

SPRAYING CLEARS CANALS

PN-1469

PN-1470

A canal (above) in Plantation Isles before treatment with herbicide. Note weed has grown up to surface of water. In photo at left workers apply herbicide to canal surface. Small air fan on the back of the boat was necessary to propel it over the weed surface.

A DENSELY GROWING waterweed that is an unsightly nuisance in the canals of southeastern Florida can now be successfully combatted.

The weed is elodea (*Elodea canadensis*) and the control weapon is amine salt of endothall, a herbicide registered for use in controlling aquatic weeds.

Seven days after ARS botanist R. D. Blackburn and agronomist L. W. Weldon treated the canals in a residential development at Plantation, Fla., with the herbicide, homeowners could use their boats for the first time in 6 months. After 30 days, the canals were free of all vegetation.

The treatment controlled the weeds with hardly any effect on fish. Only those fish trapped in the dense vegetation and unable to escape the direct application of the herbicide were killed. These fish, the scientists believe, would have suffocated in the vegetation had it not been treated to kill weeds.

The study was conducted in cooperation with the Old Plantation Water Control District, Plantation, Fla. Canals in this residential development were densely infected with elodea, which was fouling boat traffic, interfering with drainage and irrigation, causing flooding and undesirable odors, and reducing fish populations.

Before the herbicide was used throughout the canal system, Blackburn and Weldon ran tests on small plots in three canals to study its effect on the weeds, the fish, and the water.

The scientists also evaluated diquat and granular copper sulfate in the small plots, but these herbicides were not effective in controlling the weed.

In tests on the small plots after the first canal treatment, the researchers found that elodea could be controlled effectively with half the amount of herbicide originally used. Accordingly, Blackburn and Weldon made this reduction for the second treatment of the entire canal system.

Homeowners received notices before the large-scale application of the herbicide indicating the date their canals would be treated and warning them not to use the water for any purpose for 7 days after treatment.

Elodea usually grows back about 6 months after amine salt of endothall is applied, but Blackburn and Weldon believe regular applications will increase the period of control.

The scientists are continuing their research to develop more effective methods to prevent regrowth of the weed without affecting the quality of the water or the production of fish and other organisms.■

BURNING PROTECTS CROPS

PN-1474

Worker burns weeds in ditch using propane-fueled torch. The green peach aphid and the yellows virus it carries survive winters in weed-infested ditches like this one. Burning has been more effective than conventional pesticides in tests, and burning is a less expensive control method.

BY BURNING WEEDS IN drainage ditches, farmers in the Northwest can cut disease losses of sugarbeets.

The weeds are host plants of the green peach aphid, carrier of yellows virus, a disease that stunts sugarbeets, lowering their sugar content. Simply burning the weeds, thus destroying the insect's habitat, reduced sugarbeet infection by 80 percent in tests near Yakima, Wash., conducted by ARS entomologist R. L. Wallis.

Up to now, applying pesticides to ditches provided the only effective way of controlling this aphid and the virus. Wallis estimates that large area ditch burning would cost only about $2 per acre; conventional pesticides, about $18 per acre.

Wallis found that the aphids and the virus survive the winter on more than 30 weeds and other plants growing in ditches, which provide a microclimate warmer than the surrounding winter environment.

In some ditches, water fed by warm springs was 20 to 50 degrees warmer than the air. Under such conditions, virus-infected weeds such as Canada thistle, hoarycress or whitetop, Jim Hill mustard, prickly lettuce, prickly sowthistle, Russian knapweed, and shepherds-purse may become reservoirs of disease.

Aphids also survive the winter as eggs on peach trees. However, Wallis found 28 percent more diseased beets near ditches than near peach trees.

He also found that beets growing near burned ditches had 75 percent less infection than those growing near peach trees, and found 95 percent fewer aphids near burned ditches than near peach trees.

Wallis ran his tests in a 22-square mile area with 42 miles of drainage ditches. Weeds were burned with propane-fueled units on trucks at the beginning of April—before aphid flights began or beets emerged from the soil. At the end of the month, Wallis also sprayed the few peach trees located in the area to keep aphids from migrating to nearby beet fields.■

INSECTS DESTROY WEEDS

PN-1467

Canal heavily infested with alligatorweed. Growth is so heavy, canal is not navigable.

PN-1468

Same canal after flea beetle has been released to feed on the alligatorweed.

INSECTS ARE BEING drafted to serve in man's war against weeds that infest the farm, ranch, and homestead.

ARS scientists are searching the world for insects that eat only weeds. These insects are brought back to the United States for testing, in cooperation with other ARS scientists and State experiment stations. This work is led by Entomologist L. A. Andres at the ARS Biological Control of Weeds Laboratory, Albany, Calif.

Exhaustive explorations and intensive research rule out many more insects than are chosen for biological weed control, because some of them also injure useful plants. Moreover, even small differences between an insect's native habitat and the new areas where it is introduced may prevent the insect from getting established. ARS is searching for those few species that adapt to new environments and become economical, self-perpetuating allies of man against weeds.

One of these promising insects is a 1/4-inch long *Altica* beetle native to Europe. It may help control infestations of Canada thistle, a pest in large parts of the United States, particularly in the North.

A few years ago, Canadian scientists released the beetle in Ontario and Alberta. Last summer, ARS and State scientists liberated the insect in California, Idaho, Montana, Oregon, and Washington. If it establishes itself there, scientists will distribute the insect next summer in other areas infested by the Canada thistle.

Tansy ragwort, or stinking willie, a toxic weed, is being fought by two natural enemies, the cinnabar moth and ragwort seed fly (AGR. RES., Jan. 1960, p. 12, and Dec. 1966, p. 14). These insects, introduced from their native European habitats, devour leaves and seeds of the weed, which infests large areas in Oregon and California.

Another western weed, the punctturevine, may be reduced to a manageable level by two weevils from Western Europe that scientists liberated in the West and Southwest. One weevil, *Microlarinus* lypriformis, attacks the stems of the vine and the other, *M.* lareynii, eats the seeds. Punctturevines produce spiny fruit that can puncture feet and tires.

The insects, first released in 1961, are becoming established in Arizona, California, and New Mexico. Smaller numbers are also found in Texas. Scientists in Hawaii liberated the weevils there, successfully reducing infestations of the weed.

Following research in South America, in cooperation with the Army Corps of Engineers, scientists released a flea beetle of the genus *Agasicles* that feeds only on alligatorweed, a serious pest of waterways in the South and Southwest. Alligatorweed clogs canals, ruining navigation, fishing, and food for waterfowl. By interrupting the flow of water in drainage ditches, the weed also provides breeding grounds for mosquitoes.

Waterways near Jacksonville, Fla., have been clearing up since the flea beetle's introduction in 1965. But little benefit has been detected in a 600-acre test area along the Georgia-South Carolina border where the beetle was first released in 1964. Flea beetles will be liberated this spring in other southern areas infested by alligatorweed, and scientists will study their effect in those areas. ■

SPRAYER REACHES TALL WEEDS

A WEED-SPRAYING RIG that catches spray missing the weeds and uses it again has been developed to fight tall weeds.

The sprayer was developed at Stoneville, Miss., by C. G. McWhorter of ARS specifically for use against tall weeds, and is another step in a research program being conducted to find ways to control weeds in soybeans (AGR. RES., Oct. 1965, p. 12).

McWhorter believes the sprayer has potential for use in other crops where tall weeds are a problem. In addition, since a relatively small amount of herbicide contacts the crop plants, the spray system may permit the use of herbicides normally considered too toxic for some crops.

Tall weeds, especially sesbania and cocklebur, in soybean rows are a problem in the South, particularly in the Delta region. Soybeans grow shorter and fuller there than they do in the North. Thus, in the latter part of the growing season, tall weeds shoot up above the crop. At this stage, the weeds reduce potential harvestable yields of soybeans because they interfere with harvest operations.

The sprayer developed by McWhorter directs herbicide sprays at right angles to and above the soybeans. The spray passes over the top of the soybeans and contacts only the weeds growing above the crop. A recovery device catches and returns to the original spray tank the spray that misses the weeds.

The system would also reduce spraying costs because less spray is used. For example, if the sprayer is set to apply 10 gallons of spray per acre, only about 3 gallons may actually be used. The other 7 gallons is caught in the recovery device, recirculated to the spray tank, and then used again.■

Spray rig showing the spray nozzles (right) and the recovery device that catches unused herbicide and returns it to tank for use.

PN-1466

FOAM TREATMENT PREVENTS DRIFT

A DEVICE THAT CONVERTS spray to foam may eliminate drift as a problem in spraying weeds.

ARS physiologist C. G. McWhorter and W. L. Barrentine of the Mississippi Agricultural Experiment Station developed the herbicide-foam applicator at Stoneville, Miss.

They have tested it for preemergence and postemergence treatment to control weeds in soybeans. Results have been as good as with standard spray methods.

The applicator uses either a pressure tank or compressor for air, a regular spray tank for a herbicide-surfactant solution (the surfactant increases the foaming ability of the herbicide), and two plexiglass devices stuffed with rubberized bristles. Foam is produced by spraying the herbicide-surfactant solution onto the porous bristles and then forcing air through them.

Although considerable testing is needed before the foam applicator can be adapted by growers, the method appears to have several advantages. Most importantly, the drift hazard with foam is very low. This makes it possible to use some herbicides for postemergence applications that cannot be used now because they drift onto the crop and cause damage.

Secondly, better coverage is possible because the total surface area of the spray solution is increased by the addition of air. This may permit the use of reduced herbicide rates. McWhorter and Barrentine also believe this technique can be used for weeds in ditches and for aquatic weeds.

Present foam applicators are designed primarily for row crops. The foam can be directed to the soil surface in the row in a preemergence application, or it can be applied as a postemergence treatment by directing the foam to the bases of the crop plants in the row.■

Tractor operator applies postemergence foam treatment to soybeans. The foam is produced in the fan-shaped devices on each side of the row.

PN-1465

ARS engineer K. J. Moulton draws MAZDA from the ozonizing tank where methyl esters derived from soybean oils were treated.

PN–1472

New Oil Process For Industrial Products

SOYBEAN OR LINSEED oil derivatives can be converted into a new raw material for making industrial products such as adhesives, coatings, films, plasticizers, and plastics through a new process developed by ARS.

The raw material is methyl azelaaldehydrate dimethyl acetal (MAzDA). It is made by treating methyl esters derived from soybean or linseed oils with ozone, a form of oxygen. Esters of other oils or fats might also be used.

The laboratory ozonization procedures were developed at the ARS Northern utilization research laboratory, Peoria, Ill., by chemists E. H. Pryde, D. J. Moore, R. A. Awl, W. R. Miller, H. M. Teeter, and J. C. Cowan. Engineers R. E. Beal and K. J. Moulton at the Northern laboratory developed techniques that lower the cost of the process and make it safer.

L. I. Hansen, P. E. Throckmorton, and R. C. Christensen, researchers for a Minneapolis firm, developed ways to use the process in industrial production under an ARS contract.

These scientists estimate that a plant capable of producing about 10 million pounds of MAzDA a year would cost about $3.2 million. In such a plant, MAzDA could be made to sell at a price comparable to the present price of competing chemicals.

One of the most promising materials made from MAzDA is a nylon, called nylon 9, especially suited for use in electrical insulation and gears, bearings, cams, and other close-tolerance parts in equipment such as pumps, washing machines, and water meters.

Nylon 9 absorbs less moisture and swells less in water and moist atmospheres than nylon 6, a well-known nylon in the United States. Among nylons with low water absorption, nylon 9 has one of the highest melting points. And even after melting, it is unusually heat stable, which simplifies the process of spinning it into fiber. It also weighs less and is more resistant to chemicals than some other nylons.

Reacting MAzDA with alcohol produces plasticizing compounds that give flexibility to polyvinyl chloride. Two of the plasticizers made from soy MAzDA kept polyvinyl chloride flexible at lower temperatures and stable at higher temperatures than plasticizers now used by industry. Plasticized polyvinyl chloride is used to make such products as raincoats, upholstery, refrigerator door gaskets, garden hose, and shower curtains.

Another MAzDA product is ideally suited for use in a gas-liquid chromatograph, an analytical research instrument. The product separates mixtures into their component parts and holds them separately, which aids in identification. It is more efficient for separating some compounds, and makes possible some analyses that could not be made before.■

Composite Cross for Barley

PLANT BREEDERS IN California have developed a complex barley population that may lead to new barley varieties with multiple disease resistance, improved adaptability, and superior agronomic traits.

Developed by ARS and the California Agricultural Experiment Station, the barley population, Composite Cross XXV, was produced by crossing Ethiopian barleys with superior U.S. barleys adapted to various growing regions. The population was developed to provide plant breeders with a source of resistance to barley yellow dwarf virus (BYDV), a serious and widespread disease of barley.

The disease, first reported about 1950, is spread by aphids, and resistant plant varieties offer the only effective control. Although thousands of barleys were examined, the only source of high level resistance was found in varieties from Ethiopia.

In addition to having BYDV resistance, Ethiopian barleys tiller vigorously (grow shoots from the crown), have large seeds, and are resistant to most of the other major barley diseases. But they are not adapted to production in the United States.

Under California conditions, the C. C. XXV population matured relatively early and showed good resistance to BYDV. Seed of the population has been released to plant breeders for use in developing new commercial barley varieties.■

Edible Fat Cuts Packaging Costs

The new edible fat is shown in solid form.

BN–10169

A TASTELESS, COLORLESS fat has led to major changes in the packaging of nuts and may change the packaging of meats and produce.

ARS scientists at the Southern utilization research laboratory, New Orleans, developed the fat in their search for new ways to use cottonseed oil. The fat protects foods from the effects of oxygen, freezer burn, and dehydration and from discoloration during refrigeration.

At temperatures below 115° F., the fat is pliable, waxy, and solid. Sprayed on the product in a very thin film, it locks out oxygen and retards rancidity for long periods, eliminating the need for canning and thus cutting processing costs. Packaging treated nut meats in bags, for example, costs only about 15 to 20 cents per case; canning costs about 95 cents per case.

The fat currently costs about 50 cents per pound to produce, but it is expected to drop in cost with improved production techniques and increased consumer demand for additional conveniences in food marketing and preparation.

Chemists R. O. Feuge and N. V. Lovegren at the New Orleans laboratory say that the chemically modified fat can be left on such foods as meats, poultry, or fish to become part of the frying fat or gravy. Or, it can be removed before cooking by holding the coated food under hot running water for a few moments.

Other uses include coatings for cheeses; emulsifiers in cake mixes, icings, and cream fillings; and lubricants for food processing machinery. The fat is already used in shaving creams, baby oils, hair sprays, foundation creams, lipsticks, and other cosmetics.

To produce the new fat, vegetable oil or animal fat is chemically reacted with triacetin, a commercially available oil rich in acetic acid. During the reaction some of the fatty acids in the oil are replaced with acetic acid from the triacetin. When the reaction is complete, the new fat is distilled from the mixture.

About 35 million pounds of edible coatings are used on food products where the new fat might compete. USDA economists estimate that the potential market may rise to about 75 million pounds annually in the next few years.■

Oil From Celery Wastes

CELERY LEAVES, RIBS, and cull stalks formerly wasted in harvesting can now be made into a celery oil with a more characteristic aroma than oil produced from celery seed.

ARS chemists C. W. Wilson III and A. M. Neubert at Winter Haven, Fla., have developed a process for removing oil from the waste material. It is a result of their search for a way to heighten the flavor of an improved dehydrated celery developed recently (AGR. RES., June 1965, p. 14).

The scientists separate the oil from the waste material by distilling with steam at atmospheric pressure. The resulting distillate is concentrated in a column and the vapors are condensed. Finally, oil in the concentrate is separated by a special oil trap.

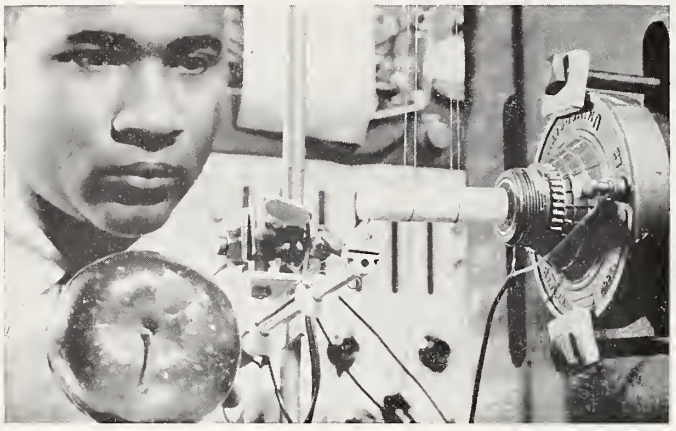
Development of the process is another step forward in ARS research conducted to find new uses for agricultural products. Celery is one of the Nation's top 10 vegetable crops, with an annual farm value of more than $60 million.

Celery's unique and appetizing flavor makes it highly desirable in processed foods. Processors are using increasing amounts of dehydrated celery because fresh celery is not always available. However, the heat used in removing moisture from celery also drives off flavor and aroma.

Oil obtained by the new process—10 times more potent than oil from the seed—can be used to replace the lost flavor and aroma. And, although a ton of material produces only five ounces of oil, those five ounces should, theoretically, flavor a ton of material.

Wilson and Neubert believe dehydrated celery could be reflavored with the oil right after drying by spraying a fine mist on it while it is being tumbled. But this is desirable only if the dehydrated celery is to be rehydrated very slowly. If rehydrated rapidly, the heat would drive the flavor off again.■

Sound Measures Firmness of FRUITS AND VEGETABLES



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WILL AUTOMATION REPLACE the thumb, that device well known to grocery store managers and used by shoppers to evaluate peaches, plums, and tomatoes with a squeeze and a pinch?

ARS market quality researchers at Beltsville, Md., think it will. They are developing instruments to test fruit and vegetables in the market place.

Eventually, the researchers believe, these instruments may tell producers when to harvest their crops for the best quality, and packers when to take produce out of storage and put it on the market for peak flavor.

Agricultural engineer E. E. Finney has determined that sound can be used to measure firmness, and indication of quality in apples, potatoes, bananas, and other fruits and vegetables.

Finney explains that a fruit or vegetable, or nearly any other object, has a natural frequency. Sound passes through the object better at this frequency than at any other. The natural frequency is directly related to softness or firmness—rubber, extremely soft, has a low natural frequency; steel, extremely hard, a high natural frequency.

By testing large quantities of various fruits and vegetables, Finney has established standards based on the average natural frequencies of each type of produce. Now, by passing sound waves through a fruit or vegetable, he can determine its softness or firmness by comparing its natural frequency to the standard for the type.

In future research, Finney and other market quality scientists will work toward combining sound and light measurements to determine produce quality.■

WATERSHED DATA COMPILED

CONTROL OF RUNOFF water—that portion of normal rainfall that carries away topsoil, makes gullies along roadsides, and pollutes streams—is a step closer because of a battery of statistics recently compiled at the ARS Hydrograph Laboratory in Beltsville, Md., and available on request from the laboratory.

For the past year, the scientists have been testing soil samples dug from more than 200 experimental watersheds throughout the United States. The results of their study are now available to soil technicians, hydrologists, and others charged with preserving the Nation's soil and water resources (AGR. RES., November 1965, p. 3).

The data will provide a basis for analyzing rainfall-runoff relationships by computer and will help solve conservation problems in other watersheds throughout the country.

Mathematical formulas now being developed will make the watershed data adaptable to projection by computer. Scientists will thus be able to answer many questions of the performance of a given watershed without first accumulating long-term records of the watershed.

H. N. Holtan, director of the Hydrograph Laboratory, said that the key to the study is the data that it contains on the surface layer of soil—the root zone. Where roots grow, soil is permeable, and water descends by force of gravity. Below the root zone, soil becomes less permeable and water can descend only by capillary action—a much slower process. The soil of the root zone is like a layer of sponge; when it becomes saturated, runoff results.

The study, Holtan said, shows the moisture-holding capacity of each type of soil tested and the estimated rate at which it can absorb moisture. This information can be combined with records of rainfall and storm frequency to calculate the runoff potential of the watersheds under study.

Runoff, Holtan pointed out, can be controlled through cropping systems, proper tillage, and engineering structures such as dams and terraces. With the information developed at the Hydrograph Laboratory, scientists will be able to figure out what types of conservation practices are needed, where they are needed, and whether they are economically feasible.■

RARE DISEASE FOUND IN HOGS

ARS SCIENTISTS HAVE FOUND that a rare, inherited, human disease also occurs in hogs.

Their finding is a notable addition to the understanding of scientists doing research on the disease in children and on other causes of birth defects.

The disease, called generalized ossifying myositis, causes bone-like material to form in the ligaments, tendons, and muscles surrounding normal bones.

The condition was found in a boar used for breeding on three adjoining farms in Wisconsin. The animal was apparently normal until nine months of age. At that time, its right hind leg suddenly became enlarged. The enlargement rapidly increased and within a month the boar was nearly immobilized in the hind quarters.

The boar was slaughtered and affected portions were forwarded for study to ARS veterinary pathologists H. R. Seibold at Chicago (now at the Plum Island Animal Disease Laboratory, Greenport, N.Y.) and C. L. Davis at Denver. Scientists at the Armed Forces Institute of Pathology in Washington, D.C., also examined microscopic samples of the enlargements and found the pathological alterations consistent with generalized ossifying myositis in children.

The ARS pathologists were able to study many of the pigs sired by this boar. Among the 115 live pigs it fathered, 34 developed a similar disease condition.

These pigs appeared normal at birth, but when 2 to 6 months of age developed firm enlargements in various locations along the spine. When first noted, the enlargements seemed to be very painful—the affected pigs were very stiff and reluctant to move. Within a week, the swellings got several times larger. The affected pigs lost weight rapidly, probably because they were reluctant to move to the feed troughs.

When they examined the enlargements, the scientists found bone developing along the spine and extending deeply into and replacing muscles and tissues. Although the pathologists first suspected the bone growths to be some type of cancer, they later decided the ailment was caused by a genetic defect of connective tissue in the boar that could be transmitted only to his progeny.

PORTABLE KIT DETECTS PESTICIDE RESIDUES

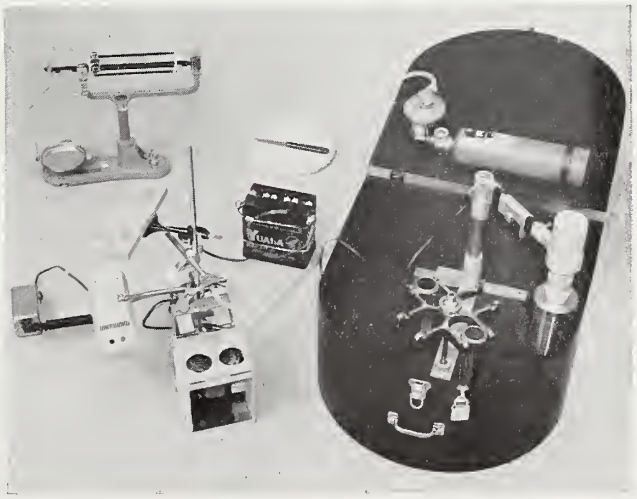
ON-THE-SPOT FIELD tests to determine whether a food sample contains illegal pesticide residues may be possible with a portable kit developed under an ARS contract.

The kit is one result of a series of ARS projects to develop simple, rapid methods to detect pesticide residues in raw and processed foods. It might be used by food inspectors, graders, and others who have little or no chemical training.

Contained in three cases and weighing less than 100 pounds, the kit provides all the equipment and supplies necessary for an 8-hour workday, during which four to eight samples can be analyzed. With it, an operator could check quickly a carload of grain, a meat carcass, a shipment of fruits and vegetables, or a tank of milk for illegal levels of pesticide residue. Legal levels are established by the Food and Drug Administration.

The assurance that residues are absent would be an added quality factor for consideration by buyers, graders, and inspectors. With the kit, hundreds of samples could be screened and only those showing residues higher than established tolerances would be submitted to central laboratories for specific analysis.

The kit contains chemicals and glassware needed for analyses, a small motor powered by a 12-volt battery which runs a blender and centrifuge, a small electrolytic heater fueled by propane, and an ultraviolet light for reading plates.



The kit showing all parts set up and ready for use. It is both a time-saving and labor-saving device.

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AGRISEARCH NOTES

Control Against Flag Smut

WHEAT GROWERS IN THE Pacific Northwest may soon have a positive control against flag smut, a potentially dangerous disease of wheat.

ARS researchers at Pullman, Wash., have found that flag smut resistance can probably be transferred from resistant breeding lines into the susceptible semidwarf wheat varieties that are commercially popular in the Pacific Northwest.

Flag smut, unlike other more widespread and devastating diseases, has not seriously threatened yields in the Pacific Northwest, and infections have been largely isolated. But the disease is now spreading and infesting new areas.

To learn how easily flag smut resistance could be transferred from resistant to susceptible lines, plant pathologist L. H. Purdy and geneticist R. E. Allan tested five breeding lines and three crosses involving the five lines, in cooperation with the Idaho, Oregon, and Washington Agricultural Experiment Stations.

The breeding lines varied in resistance to flag smut. Two lines, Dickson 114 and a cross between Norin 10 and Brevor 14, were apparently immune. Two other lines, Itana and C.I. 13447, were moderately susceptible, while Brevor, the fifth line, was susceptible.

When the immune lines were used as parents in crosses with the three susceptible lines, Purdy and Allan found that the genes controlling flag smut resistance could be transferred more easily from the Norin 10 x Brevor 14 line than from the Dickson 114 lines. This finding is important because the semidwarf growth habit of wheats grown in the Pacific Northwest was derived from the Norin 10 x Brevor 14 line.

Under greenhouse conditions, the scientists can accurately select plants for flag smut resistance as early as the third generation. Thus, they can rapidly screen wheat lines grown in a flag smut resistance program. In the ARS tests, later generations of test lines did not differ significantly from the third in their reactions to the disease.■

Harvester for Cotton Plots

COTTON RESEARCHERS MAY soon have the answer to fast, efficient harvesting of their test plots.

ARS agricultural engineer A. D. Brashears and agronomist L. L. Ray of the Texas Agricultural Experiment Station, Lubbock, are developing an experimental stripper-type harvester that can harvest 60 two-row, 50-foot test plots per hour.

Time is important in harvesting experimental cotton. Hand-picking usually takes several days, and during this time the quality of the fiber changes. Conventional harvesting machines are often not flexible or convenient enough for use by researchers.

The new two-row stripper can harvest test plots rapidly, economically, and efficiently regardless of field layout or test design.

The machine has five basic parts: (1) a unit that strips the cotton from the stalks; (2) a conveying system that directs the cotton into sacks or, when it is not necessary to sack all cotton, into a trailer behind the harvester; (3) a unit that separates green bolls from the stripped cotton; (4) a sacking attachment; and (5) a platform for storing the full sacks.

Cotton harvested from the plots can be kept separate according to rows, or both rows can be sacked together. Cotton from either or both rows can be diverted into the trailer. Sacked samples are kept on the platform until they are unloaded at the end of the row.

Four men are needed for the experimental harvester. Two men on the platform catch the samples, one man catches the green bolls, and one man operates the machine.

The new cotton stripper is not commercially available, but details for construction may be requested from the developers at the Texas Experiment Station.■

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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